AMENDMENTS TO THE SPECIFICATION

Please amend the paragraph beginning on page 2, line 18 as follows:

Next, according to the method in JP-A-10-324600, ~~a~~ formation of a polycrystalline film of a β(cubic)-SiC or α(hexagonal)-SiC on a surface of an α-SiC single crystal substrate (seed crystal) by thermal chemical vapor deposition (CVD) and thermal treatment ~~to a~~ of the composite body ~~by~~ resulting from the formation are repeated a plurality of times so that a plurality of α-SiC or β-SiC polycrystalline films are oriented (the kind of ~~sold~~ solid phase epitaxial growth) in ~~a~~ the same direction of the crystal axis of the α-SiC single crystal substrate (seed crystal). Thus, SiC single crystals are formed so as to have ~~less~~ few micro-pipe defects.

Please amend the paragraph beginning on page 3, line 12 as follows:

According to the above-described first method, the epitaxial film should be grown to a thickness ~~at~~ of about 20 to 75 μm or more by the liquid phase epitaxy method, to obtain a region where the micro-pipes are eliminated. Moreover, an epitaxial film on which devices are formed is formed on the epitaxial film by liquid phase ~~epitaxty~~ epitaxy by a CVD method, so that a ~~problem is caused that~~ number of manufacturing ~~process increases~~ processes increase.

Please amend the paragraph beginning on page 3, line 19 as follows:

According to the above-mentioned second method, SiC composite is obtained so as to include crystal boundaries therein since the polycrystalline film is formed on the single crystal substrate. When the composite is subjected to the thermal treatment to cause the solid phase epitaxy on the seed crystal, there is possibility that crystal defects due to internal stress at the crystal boundaries in the polycrystalline film are introduced. These defects become sources of

traps, and therefore there is a problem that this substrate is not suitable for a substrate to form devices. Moreover, the formation of the film, the thermal treatment, and a surface flattening should be repeated ~~some tomes~~ several times to grow ~~at a thickness of a practical~~ a substrate having a practical thickness. Thus, ~~a problem is caused that~~ manufacturing ~~process increases~~ processes increase so that manufacturing cost becomes high.

Please amend the paragraph beginning on page 4, line 11 as follows:

According to the above-mentioned fourth method, although the micro-pipes are occluded by thickening the epitaxial film, a thickness of the epitaxial film to form devices on the substrate is ~~at a degree of~~ about 20 to 30 µm at most. Therefore, there is a need that the micro-pipes are occluded even if the epitaxial film is thin. Besides, the growth rate is ~~slow~~ ~~in such the degree of~~ only about 16 µm /h~~,~~. ~~it~~ It takes ~~long~~ many hours, i.e., 4 hours or more to occlude the micro-pipes. That is, this method is not suitable for a commercial use as a method for forming an epitaxial film for devices or bulk.

Please amend the paragraph beginning on page 5 line 1 as follows:

According to a first aspect of the present invention, when an epitaxial film is formed on a silicon carbide substrate having a micro-pipe, temperature difference is applied between a front surface of the substrate and a back surface of the substrate that is disposed opposite to the front surface so that the front surface is at a low temperature.

Please amend the paragraph beginning on page 5, line 7 as follows:

By lowering the temperature at the front surface of the silicon carbide substrate as compared to the back surface, sublimation gas of SiC is generated at the vicinity of the back surface where the temperature is high (the micro-pipe or the back surface)~~,~~. The sublimated gas flows to a side of the front surface through the micro-pipe, and then ~~are~~ recrystallized at the vicinity of the front surface where the temperature is low. At that time, the gas is recrystallized at an inside of the micro-pipe, so that an inner diameter of the micro-pipe becomes small, and finally, the micro-pipe can be occluded.

Please amend the paragraph beginning on page 5, line 17 as follows:

Incidentally, as described in a second aspect of the present invention, by setting a temperature of the substrate at 1650 °C or more, sublimation is apt to occur from the substrate, and occlusion of the micro-pipe is ~~encouraged~~ stimulated.

Please amend the paragraph beginning on page 5, line 21 as follows:

Moreover, as described in a third aspect of the present invention, by setting the temperature of the substrate at 1750 °C or more, sublimation is ~~encouraged~~ stimulated from the substrate, so that the micro-pipe is occluded easily. However, in a case where the temperature exceeds 1900 °C, the sublimation is ~~encouraged~~ stimulated so that the sublimation and a recrystallization are balanced so as to restrain the occlusion of the micro-pipe. Therefore, the temperature of the silicon carbide substrate is preferably set to 1900 °C at most.

Please amend the paragraph beginning on page 6, line 3 as follows:

Moreover, as described in a fourth aspect of the present invention, since hydrogen gas or helium gas has a high heat-transmitting characteristic so as to effectively lower the temperature at the front surface of the silicon carbide substrate where the gas is supplied, so that the temperature difference between the front surface and the back surface of the substrate is sufficiently generated. Thus, ~~it is encouraged that~~ the sublimation gas from the vicinity of the back surface of the silicon carbide substrate is transferred to the front surface.

Please amend the paragraph beginning on page 6, line 12 as follows:

Moreover, as described in a fifth aspect of the present invention, by setting a flow rate of the gas at 1 m/sec or more, the temperature at the front surface of the silicon carbide substrate where the gas is supplied is effectively lowered so that the temperature difference between the front surface and the back surface of the substrate is sufficiently generated. Thus, ~~it is encouraged that~~ the sublimation gas from the vicinity of the back surface of the silicon carbide substrate is transferred to the front surface.

Please amend the paragraph beginning on page 9, line 4 as follows:

Moreover, as described in a sixteenth aspect of the present invention, when an opening of the micro-pipe is enlarged in the silicon carbide substrate, a plurality of steps ~~is~~ <u>are</u> formed at the opening. ~~By being~~ <u>Since</u> the steps ~~as~~ <u>are</u> cores, a lateral growth of a silicon carbide film progresses, and therefore~~,~~ the micro-pipe can be easily occluded.

Please amend the paragraph beginning on page 10, line 18 as follows:

Moreover, as described in a twenty-second aspect of the present invention, by forming the epitaxial film on a silicon carbide substrate having a micro-pipe with an opening whose diameter increases as being close to a front surface of said substrate, a substrate can be obtained, in which the silicon carbide epitaxial film is not opened on the micro-pipe~~,~~. ~~so that~~ Therefore, a high quality silicon carbide single crystal substrate which has less micro-pipe is produced. ~~so as to be high quality can be produced.~~ Besides, the micro-pipe is ~~eliminated~~ occluded (or terminated) in this silicon carbide substrate ~~and that~~ , which can be an advantage for producing devices since a thickness of the epitaxial film is usually considered ~~as usual~~ in producing the devices without considering a location of the micro-pipe.

Please amend the paragraph beginning on page 11, line 9 as follows:

Moreover, as described in a twenty-fourth aspect of the present invention, when the micro-pipe is ~~eliminated~~ occluded (or terminated) at a conductive region disposed between the silicon carbide substrate body and the epitaxial film, and the devices are formed in this substrate, in a case where a voltage is applied so as to expand a depletion layer, the depletion layer that is expanded from the epitaxial layer is restrained from being expanded by the conductive region so that the depletion layer is prevented ~~form~~ from reaching the micro-pipe. Therefore, electric field concentration at the micro-pipe, which is caused by the phenomenon in which the depletion layer reaches the micro-pipe, is suppressed so that a breakdown due to the micro-pipe can be prevented.

Please amend the paragraph beginning on page 12, line 3 as follows:

Otherwise, as described in a twenty-seventh aspect of the present invention, the conductive region is a low ~~resistive~~ resistivity epitaxial film. In this case, the depletion layer expanding from a high ~~resistive~~ resistivity epitaxial film formed on the low ~~resistive~~ resistivity epitaxial film is restrained from expanding by the low ~~resistive~~ resistivity epitaxial film. As a result, the breakdown due to the micro-pipe is prevented.

Please amend the paragraph beginning on page 13, line 13 as follows:

Hereinafter, an embodiment adopting the present invention will be ~~concretely~~ explained ~~using figures~~. The present embodiment adopts the present invention to a method for producing an epitaxial film for forming a device such as a field effect transistor (MOSFET or the like), a junction field effect transistor (JFET), or a ~~Schottkey~~ Schottky barrier diode on a silicon carbide single crystal substrate (SiC single crystal substrate) which is produced by, for example, sublimation ~~method~~.

Please amend the paragraph beginning on page 13, line 22 as follows:

FIG. 1 shows a schematic view of a ~~CVD (~~Chemical Vapor Deposition~~)~~ (CVD) apparatus for forming an epitaxial film on a SiC single crystal substrate 10. The SiC single crystal substrate 10 is disposed in a susceptor 30 composed of carbon and having a cylinder shape. The susceptor 30 is surrounded by a heat insulator 31 so as to prevent heat radiated from the heated-up susceptor from leaking out to the outside. Moreover, ~~all of them~~ the susceptor 30 and the heat

insulator 31 are surrounded by a reactor 32 which is composed of quartz. A coil 33 is disposed at a periphery of that so that the susceptor 30 is heated up by high frequency induction heating.

Please amend the paragraph beginning on page 14, line 11 as follows:

Hereinafter, an example in which epitaxial growth is performed in this apparatus will be explained using FIGS. ~~2 and 3~~ 2A-3B.

Please amend the paragraph beginning on page 15, line 7 as follows:

After the temperature of the substrate 10 reaches 1800 °C, a mix gas, in which the SiH_4 gas and C_3H_8 gas as source gases are added to the hydrogen gas, is introduced, so that a SiC epitaxial film 14 is grown on the front surface of the substrate 10. Incidentally, a flow of the hydrogen gas is at 10 ~~litters/min~~ liters/min.

Please amend the paragraph beginning on page 16, line 24 as follows:

Moreover, since the flow rate is fast, growth rate is high, such as 50 μm/h. Even if a thickness of the epitaxial film is 10μm, the micro-pipe 11 can be occluded at the front surface of the SiC substrate 10 without being ~~inherited~~ absorbed into the epitaxial film.

Please amend the paragraph beginning on page 17, line 2 as follows:

Incidentally, a direction of the gas flow and a disposed orientation of the substrate are not limited to the case shown in FIG. 1. The front surface of the substrate may be oriented to a lower

side. Moreover, the gases may flow in an ~~ups-and-downs~~ up-and-down direction and the front surface of the substrate is disposed in parallel with the flow.

Please amend the paragraph beginning on page 18, line 5 as follows:

Hereinafter, an example in which epitaxial growth is performed in this apparatus will be explained using FIGS. ~~5 and 6~~ 5A-6B. Conditions for growth ~~is~~ are the same as the first embodiment.

Please amend the paragraph beginning on page 18, line 20 as follows:

After the temperature of the substrate 10 reaches 1800 °C, a mix gas in which the SiH_4 gas and C_3H_8 gas as source gases are added to the hydrogen gas is flowed, so that a SiC epitaxial film 14 is grown on the front surface of the substrate 10. Incidentally, a flow of the hydrogen gas is at 10 ~~litters/min~~ liters/min.

Please amend the paragraph beginning on page 19, line 6 as follows:

Meanwhile, at the front surface of the substrate 10, the source gases flow with the hydrogen toward the substrate, so that the sublimation gas sublimed from the vicinity of the back surface of the substrate 10 cannot exit from the front surface to the outside of the substrate 10~~,~~. ~~so that~~ Therefore, recrystallization on an inner wall of the micro-pipe defect 11 at the vicinity of the front surface is ~~encouraged~~ possible. As time passes, the number of crystals ~~increases which~~ that are recrystallized at the inner wall of the micro-pipe defect 11 increases~~,~~. ~~at last,~~ Finally, the

micro-pipe defect 11 is occluded while the epitaxial film grows on ~~that~~ the micro-pipe defect, so that the micro-pipe does not extend in the epitaxial film 14 (FIGS. 6A and 6B).

Please amend the paragraph beginning on page 19, line 23 as follows:

In this embodiment, similarly to the above-mentioned second embodiment, another example in which epitaxial growth is performed in the apparatus shown in FIG. 4 will be explained using FIGS. ~~7 and 8~~ 7A-8B.

Please amend the paragraph beginning on page 20, line 17 as follows:

After that, SiH_4 gas and C_3H_8 gas as source gases are introduced to form a SiC epitaxial film 14 on the front surface of the substrate. At that time, the epitaxial film 14 grows while a growth in a lateral direction ~~is encouraged~~ progresses~~,~~. ~~which~~ The growth is faster than that on the front surface~~,~~ ~~by~~ due to a synergistic effect in which a plurality of steps ~~is~~ are formed at an enlarged opening as cores for growth, and a surface of the opening approximates the a-surface from a face orientation of the front surface. As a result, a thickness of the epitaxial film becomes thicker, and finally the micro-pipe 11 is occluded, and the epitaxial film grows on ~~that~~ the micro-pipe 11. Therefore, the micro-pipe defect 11 is not ~~inherited~~ absorbed into the epitaxial film (FIGS. 8A and 8B).

Please amend the paragraph beginning on page 21, line 2 as follows:

Further, in this embodiment, similar~~ly~~ to the second embodiment, the micro-pipe defect 11 is ~~encouraged being~~ occluded by a sublimation gas of SiC.

Please amend the paragraph beginning on page 21, line 5 as follows:

Incidentally, as a method for forming the opening at the surface of the micro-pipe defect 11, a gas containing chlorine instead of hydrogen may be introduced to obtain ~~the~~ a similar effect. In a case where chlorine is employed, it is unnecessary to heat up the substrate. In the case where hydrogen is employed, it is preferable that the substrate is heated up to 1650 °C or more. This is because etching effect by using hydrogen is not apt to appear at low temperatures, and therefore it takes long time to enlarge the opening at the surface of the micro-pipe defect 11.

Please amend the paragraph beginning on page 21, line 20 as follows:

Although the embodiments of the present invention are described above, ~~it is not necessarily that~~ the occlusion of the micro-pipe defect is not necessarily achieved in the SiC substrate 10 in ~~view of producing~~ in order to produce devices. In this embodiment, as another example shown in FIGs. 9A and 9B, an occluded location of micro-pipe defect will be explained in view of a relation between a withstand voltage of the devices and the micro-pipe defect.

Please amend the paragraph beginning on page 22, line 8 as follows:

FIG. 9A shows the low resistivity substrate 20 on ~~which~~ the n^--type epitaxial film 14 having a low impurity concentration. In this case, when a p-type region is formed in or on the n^--type epitaxial film 14 to serve as a device, and when a reverse bias is applied to a p-n junction formed in the substrate, ~~it~~ there may be ~~supposed~~ a case where the depletion layer expands to penetrate the n^--type epitaxial film 14 and reach the SiC substrate 20. Since an impurity concentration of the SiC substrate 20 is high, the depletion layer hardly expands in the SiC substrate 20.

Please amend the paragraph beginning on page 22, line 17 as follows:

Therefore, when the micro-pipe defect 11 is occluded in the SiC substrate 20, the depletion layer does not reach the micro-pipe defect 11, and therefore the breakdown due to the micro-pipe defect 11 is prevented from occurring.

Please amend the paragraph beginning on page 22, line 26 as follows:

~~As one of methods for forming this structure, there is a~~ A method in which the n^+-type epitaxial film 21 is formed at 1750 °C or less may be utilized to form the above structure. Also in this case, similar~~ly~~ to the case shown in FIG. 9A, it is preferable that the micro-pipe defect 11 is occluded in the low resistivity region since the micro-pipe defect 11 may not influence the withstand voltage.

Please amend the paragraph beginning on page 23, line 10 as follows:

FIGs. 10A and 10B ~~shows~~ show a modification of the structure, shown in FIG. 4, to hold the SiC substrate 10 in the CVD apparatus.

Please amend the paragraph beginning on page 23, line 12 as follows:

As shown in FIG. 10A, a substrate holder 37 protrudes from a side face of the susceptor 30 to hold SiC substrate 10. A heat equalizer 38 composed of carbon is disposed on the back surface of the SiC substrate 10 so as to closely contact the back surface of the SiC substrate 10. All portions of the SiC substrate 10 are equally heated up to the temperature of 1750 °C or less by the heat equalizer 38.

Please amend the paragraph beginning on page 23, line 19 as follows:

As such, by making the heat equalizer 38 contact the back surface of the SiC substrate 10, even if the micro-pipe defect penetrates the SiC substrate 10, the micro-pipe defect is occluded at the front surface of the SiC substrate 10~~,~~. ~~and the~~ The sublimation gas sublimed from the vicinity of the back surface of the SiC substrate 10 is apt to move to the front surface of the SiC substrate 10 ~~in~~ by epitaxial growth. As a result, the occlusion of the micro-pipe defect ~~is encouraged~~ occurs.

Please amend the paragraph beginning on page 23, line 27 as follows:

Moreover, as shown in FIG. 10B, the heat equalizer 38 does not contact the SiC substrate 10 with a space interposed therebetween, but contacts the substrate holder 37. The substrate holder 37 holds an entire periphery of the SiC substrate 10 to form a closed space between the heat equalizer 38 and the SiC substrate 10. Therefore, a pressure due to the closed space is applied to the back surface of the SiC substrate 10 while a ~~decompressive~~ decompressed atmosphere exists on the front surface of the SiC substrate 10 ~~at~~ to such a degree of, for example, 200 Torr which is low pressure as compared to the back surface.

Please amend the paragraph beginning on page 24, line 10 as follows:

Incidentally, the heat equalizer 38 may not contact the substrate holder 37, and a narrowed space may be formed between the heat equalizer 38 and the SiC substrate 10 that is ~~narrow at~~ only about several mm or less.

Please amend the paragraph beginning on page 24, line 14 as follows:

Therefore, the sublimation gas sublimed from the vicinity of the back surface of the SiC substrate 10 is apt to move to the front surface of the SiC substrate 10, so that the occlusion of the micro-pipe defect is ~~encouraged at~~ advanced to the front surface of the SiC substrate 10.

Please amend the paragraph beginning on page 24, line 19 as follows:

As described above, when the micro-pipe defect is occluded using the temperature difference between the front surface and the back surface of the SiC substrate 10, a pressure difference between the front surface and the back surface of the substrate 10 is generated~~,~~. ~~i.e.,~~ In other words, the pressure applied to the front surface is lowered in comparison with the back surface to ~~encourage~~ permit the occlusion of the micro-pipe defect.

Please amend the paragraph beginning on page 25, line 6 as follows:

~~Others~~ Other methods will now be explained ~~which should be kept in mind in practicing the present invention~~.

Please amend the paragraph beginning on page 25, line 6 as follows:

Preferably, the temperature of the SiC substrate is at 1650 °C or more since sublimation is apt to occur from the SiC substrate at this temperature condition. For ~~encouraging~~ further advancing the sublimation ~~more~~, the temperature is at 1750 °C or more, preferably 1800 °C or more.

Please amend the paragraph beginning on page 25, line 11 as follows:

Incidentally, when the temperature of the SiC substrate exceeds 1900 °C, sublimation is ~~encouraged~~ preferred rather than recrystallization, so that there is a possibility that the micro-pipe defect cannot be occluded. Therefore, the temperature is preferably set at 1900 °C or less.

Please amend the paragraph beginning on page 25, line 16 as follows:

However, ~~it is supposed that~~ the temperature can be at 1900 °C or more, for example, approximately at 2250 °C which is a temperature of a seed crystal substrate in the sublimation method when the conditions of the growth rate, the atmosphere in the growth and the like can be suitably set.

Please amend the paragraph beginning on page 26, line 6 as follows:

Moreover, by setting the growth rate of the epitaxial film to be formed on the front surface of the SiC substrate at 20 μm/h or more, preferably 30 μm/h or more, the growth rate toward the lateral direction (a-face growth) approximately perpendicular to the thickness direction of the substrate can be enhanced, so that the micro-pipe defect can be prevented from being ~~inherited~~ absorbed into the epitaxial film.

Please amend the paragraph beginning on page 26, line 13 as follows:

Incidentally, the present invention is not limited to ~~provide~~ a substrate for a device, but may be employed in a bulk growth by utilizing a ~~merit~~ benefit that the growth rate of the epitaxial film is fast. In this case, SiC single crystals can be obtained in which micro-pipe defects are eliminated. Moreover, the SiC substrate, on which the epitaxial layer is grown by the method as described above to occlude the micro-pipe defect, can be employed as a seed crystal for the so-called sublimation method in which SiC source powder or source gases are sublimed to be recrystallized on the seed crystal so as to form a bulk SiC. In this case, sublimed gases are recrystallized on the epitaxial film disposed in a chamber composed of, for example, carbon.